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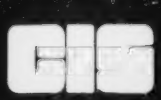

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THE ECONOMICS OF THE SHOREHAM NUCLEAR PLANT

PRINTED AT THE REQUEST OF THE

COMMITTEE ON ENERGY AND NATURAL RESOURCES

UNITED STATES SENATE

JULY 1989

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MEMORANDUM OF THE CHAIRMAN

To: Members of the Senate Committee on Energy and Natural Resources:

On April 13, 1989, this Committee held a hearing on the electricity supply situation in the northeastern United States. One major topic explored at that hearing was the proposed Settlement agreement under which the Long Island Lighting Company (LILCO) would abandon the Shoreham nuclear reactor. The Chairman of the New York Public Service Commission (PSC) testified that, under the terms of the Settlement, it would be less costly to abandon Shoreham than to operate it. To many of us attending the hearing, this claim seemed illogical.

Subsequently, Dr. Karl Hausker, the Committee Staff Economist prepared an evaluation of the New York PSC study that purports to demonstrate that shutting down Shoreham is cheaper than operating it. The evaluation concludes that the PSC study is deeply flawed; it contains several obvious biases against Shoreham operation; it fails to hold key factors constant in comparing operation vs. abandonment; and it consistently underestimates the costs of abandonment and overestimates the costs of operation.

The evaluation also concludes that, when the real economic costs associated with Shoreham's proposed shut-down are considered, operating Shoreham would save *three-quarters of a billion dollars* compared to the terms of the Settlement. In relative terms, the power produced by Shoreham would cost about two-thirds of what the equivalent amount of power would cost under the terms of the Settlement. LILCO's electric rates, with Shoreham in service, would be *lower* not higher, as the New York PSC claims.

The fate of the Shoreham plant has regional and national implications and thus is a proper subject of attention by Congress. We are releasing this report as a Committee print because it reveals the errors in the claim made by the New York PSC. Those seeking to shut down Shoreham cannot argue that their actions are justified on economic grounds. If they succeed in closing the plant, they will needlessly burden Long Island and the nation as a whole with expensive replacement energy, and will lower the reliability of the electricity supply in the Northeast.

J. BENNETT JOHNSTON,
Chairman.
JAMES A. MCCLURE,
Ranking Minority Member.

THE ECONOMICS OF THE SHOREHAM NUCLEAR PLANT

Karl Hausker
Staff Economist

U.S. Senate Committee on
Energy and Natural Resources

July 1989

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EXECUTIVE SUMMARY

The New York Public Service Commission (PSC) claims that abandoning the Shoreham nuclear reactor would be less expensive than operating it. The basis of this claim is a flawed PSC rate comparison that purports to show that electric rates for the Long Island Lighting Company (LILCO) would be lower under the terms of the Shoreham Settlement than if Shoreham were to operate.

The attached study by the Staff Economist of the Senate Energy and Natural Resources Committee shows this claim to be spurious. Measured in terms of real economic cost, operating Shoreham would save three-quarters of a billion dollars compared to the terms of the Settlement. In relative terms, the power produced by Shoreham would cost about two-thirds of what the equivalent amount of power would cost under the terms of the Settlement. Real economic costs (or economic opportunity costs) are the best measure of the societal costs of providing some good or service. They are unaffected by tax laws or accounting conventions.

This study shows that LILCO's electric rates, with Shoreham in service, would be about 0.29 cents per kilowatt-hour cheaper than rates under the Settlement. In contrast, the PSC projects that rates with Shoreham in service would be about 0.52 cts/kWh higher than the Settlement.

There are three major flaws in the PSC study as outlined below.

1. FUNDAMENTAL BIASES - The PSC study has three fundamental biases. First, it focuses on a short time horizon. The PSC study estimates levelized rates for the periods 1988-1998 (11 years) and 1988-2002 (15 years), but emphasizes its results for the former period. However, utility investments are typically analyzed over planning horizons of 20-30 years. If a utility looked ahead only 11 years, it might never build a baseload plant.

The second bias in the PSC analysis is its assumption on LILCO's equity write-off in the two scenarios. The Settlement calls for a write-off of an extra $250 million of investment in addition to the $1.4 billion disallowance that LILCO would face under either scenario. This isn't a real cost savings -- it merely shifts costs from ratepayers to shareholders. This cost shift could be accomplished with Shoreham operating as well. The Settlement would merely have shareholders take a greater loss on their investment.

Third, the Settlement analysis assumes three changes in LILCO's capital structure to compensate for what is described as the "lower risk" of the Settlement. The analysis assumes the following changes:

a) the cost of debt and equity both decline by 0.25% relative to Shoreham In-Service;

b) LILCO substitutes debt for equity, with equity as a percent of total capital dropping from 40% to 30%; and

c) LILCO refunds certain high coupon debt issues two years earlier under the Settlement.

Each of these changes in capital structure leads to lower PSC estimates of electric rates under the Settlement.

The PSC's assessment of the comparative risks is overdrawn. Shoreham In-Service carries certain risks, but the Settlement carries risks as well. These risks are not dramatically different. One can make a case for a slight decline in the cost of debt and equity under the Settlement, as the PSC has assumed. However, there is no basis for making additional compensations for the "lower risk" of the Settlement.

2. FAILURE TO HOLD KEY FACTORS CONSTANT - The second major flaw in the PSC study is that it does not hold constant two valued characteristics of a utility system: reliability and fuel diversity. Both are lower in the Settlement and thus they decrease the estimated cost of the Settlement.

Examination of the two supply plans underlying the Settlement and Shoreham In-Service reveals that the Settlement would lead LILCO to violate its bare minimum 18% reserve margin requirement in 5 of the next 7 years (1989-1995). In contrast, Shoreham In-Service easily exceeds the target reserve margin from 1989 forward. Fig. ES-1 portrays the annual reserve margins projected in the two supply plans. Clearly, the Settlement leads to lower levels of reliability, a conclusion acknowledged in the PSC study itself. LILCO would have to acquire more capacity to meet minimum reliability standards.

The second valued characteristic of a utility system not held constant in the PSC study is fuel diversity. Currently, LILCO is 100% dependent on oil and gas for power generation, with 75% of its capacity able to burn oil only. LILCO is extremely vulnerable to an sharp escalation in oil or gas prices. The Settlement would not change this, whereas Shoreham In-Service would reduce oil and gas dependence to 83%.

3. COST ESTIMATION - The final flaw in the PSC study concerns cost estimation. The PSC study uses unreasonable estimates for several specific cost factors.

The PSC assumes nuclear O&M costs and capital additions for Shoreham that are far above industry averages and offers inadequate justification for these assumptions. The analysis also

errs in incorrectly specifying the number of years for amortizing certain investments.

The fuel savings from Shoreham are highly dependent on oil prices assumed in the analysis. The PSC study uses a very low oil price forecast, far lower than the PSC's own price forecast made less than a year earlier in the Commissions Long Run Avoided Cost (LRAC) proceeding. The forecast is also far below those of other leading forecasting organizations. Fig. ES-2 displays recent oil price forecasts from the Energy Information Administration, Data Resources, Inc., and the WEFA Group. The PSC forecast is the lowest of the four shown by a wide margin.

The cost estimates for the "aggressive" demand side management (DSM) program called for in the Settlement are puzzling and may lead to a substantial underestimation of the costs of the Settlement. The aggressive program appears to reduce load growth at a far lower cost (in dollars per kilowatt) than the "base" DSM plan common to both scenarios. One would expect the opposite: the least costly DSM options should be in the base plan and LILCO should use the more costly next.

When these flaws in the PSC analysis are corrected, the analysis shows that Shoreham operation would be less expensive than the Settlement. The table below summarizes the results.

ESTIMATES OF ELECTRIC RATES & REAL ECONOMIC COSTS, 1988-2002

	Levelized Rate For LILCO System		Real Economic Cost of Shoreham Power
	PSC Estimate (cts/kWh)	Staff Estimate (cts/kWh)	Staff Estimate (MM$)
SETTLEMENT	14.44	15.51	2179.1
SHOREHAM IN-SERVICE	14.96	15.22	1431.6
SAVINGS FROM SHOREHAM OPERATION	(.52)	.29	747.5

Fig. ES-1

RESERVE MARGINS: SHOREHAM I/S vs. SETTLEMENT

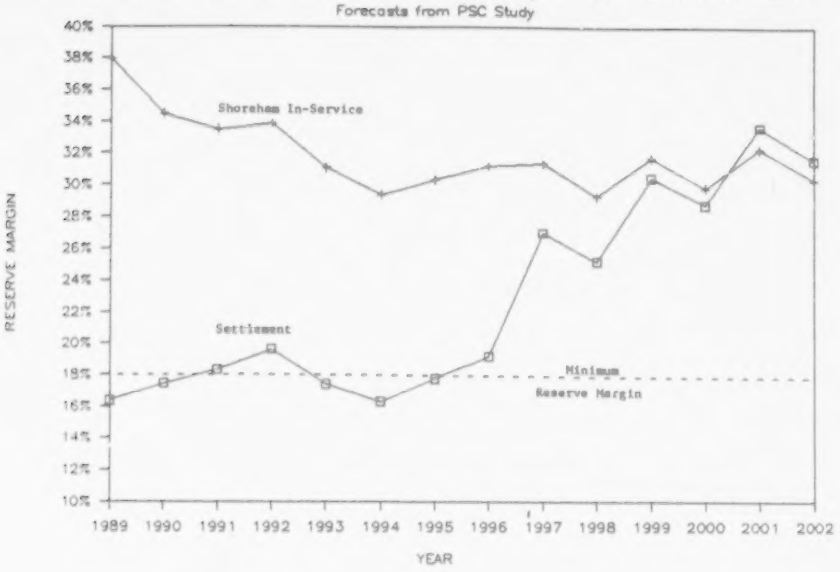
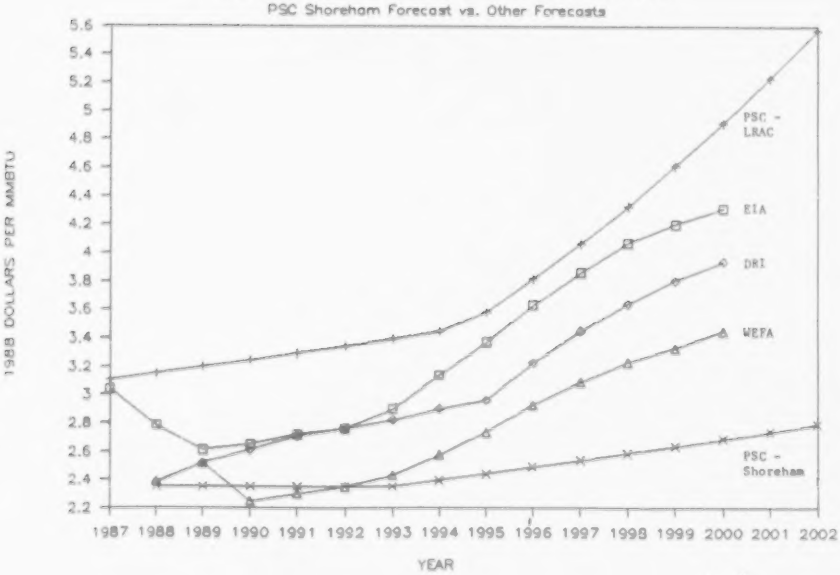


Fig. ES-2

RESIDUAL OIL PRICE FORECASTS



OVERVIEW

This study examines the economics of operating the Shoreham nuclear reactor. The impetus for the study was a hearing held by the Senate Energy and Natural Resources Committee on April 13, 1989. The subject of that hearing was the electricity supply situation in the Northeast. One major focus of the hearing was the proposed Settlement agreement under which the Long Island Lighting Company (LILCO) would abandon the Shoreham reactor. The Chairman of the New York Public Service Commission (PSC) testified that, under the terms of the Settlement, it would be less costly to abandon Shoreham than to operate it. Senators attending the hearing were incredulous at this claim. The Chairman of the Energy Committee requested his staff to evaluate this claim. This study presents that evaluation.

The study is organized as follows: Section I gives some background on the Shoreham Settlement proposal and frames the issue. It defines two perspectives on the cost of a utility supply plan: (1) the electric rates charged to customers, and (2) real economic cost (or economic opportunity cost). The subject at hand concerns two competing supply plans for LILCO: the "Settlement" and "Shoreham In-Service." This study compares the costs of each plan using both perspectives.

Section II critiques a rate comparison by the New York PSC that estimates electric rates under the Settlement and Shoreham In-Service. The PSC study concludes that LILCO's rates under the Settlement would be less expensive by 0.52 cents per kilowatt-hour (kWh). This section demonstrates that the PSC analysis contains many unreasonable assumptions, and is an inherently biased and unfair comparison. If these biases are removed and reasonable assumptions adopted, Shoreham In-Service is projected to be less expensive by 0.29 mills/kWh.

Section III offers another perspective on Shoreham. It examines the real economic costs of the Settlement versus Shoreham In-Service. This perspective constitutes a societal perspective on costs because real economic costs are the best measure of the value of society's resources consumed in supplying electricity. These costs are unaffected by accounting conventions, tax rates, or transfers among various groups. When measured in these terms, and when the biases and unreasonable assumptions in the analysis are corrected, power from Shoreham is projected to be over three-quarters of a billion dollars less expensive than the same increment of power provided under the Settlement. This represents a savings of about one-third.

Section IV explains how the Settlement tends to merely

shift costs among various groups rather than creating real cost savings. The Appendix gives selected workpapers supporting the analysis.

I. BACKGROUND

The Shoreham Settlement agreement is a proposal to permanently shut down and decommission the Shoreham nuclear plant before it ever goes into full service operation. The parties to the Settlement are LILCO, the New York PSC, the Long Island Power Authority (LIPA), and the New York Power Authority (NYPA). Key terms of the Settlement include the following:

(1) LILCO would sell the Shoreham reactor to LIPA for a nominal one dollar, and claim a $2.5 billion tax loss. LIPA would contract with NYPA to undertake the decommissioning.

(2) Subject to certain conditions and upon LILCO's request, NYPA would construct new power plants to help meet load growth in LILCO territory. LILCO would undertake an aggressive demand-side management program.

(3) The PSC would guarantee rate increases to LILCO of 5% per year for three years. The Commission projects that rate increases would have to average 5% per year for the next ten years in order to bring the Company back to financial health. LILCO would put into ratebase a "Financial Resource Asset" of $3.7 billion dollars (about $0.3 billion less than the prudent costs of constructing Shoreham as determined by the PSC).

The PSC supports the Settlement as a means of ending the controversy surrounding the Shoreham reactor. In addition, the Commission argues that rate increases under the Settlement would be less than those that would be required by Shoreham operation.

Members of the Senate Energy and Natural Resources Committee are concerned that the Settlement would contribute to electric reliability problems in the Northeast. They also argue that the Settlement would increase the nation's trade deficit and energy security problems because LILCO would burn imported oil to replace power that would otherwise come from Shoreham. Members express strong doubt that abandoning a fully constructed nuclear reactor could possibly be less costly than operating it.

The economics of operating vs. abandoning Shoreham is a key issue in this controversy (but certainly not the only one). This study examines the economics of Shoreham from two perspectives:

(1) the rates a utility must charge to meet its revenue requirement, and

(2) real economic cost (or economic opportunity cost).

Each perspective is defined below.

An electric utility charges rates that aim to cover its total cost or revenue requirement. The utility's revenue requirement is a complex calculation due to its treatment of capital costs. For instance, a power plant may be built over five years and begin operation in year six. In such a case, the revenue requirement typically does not begin until year six, at which time the plant first enters the utility's ratebase. In that year the revenue requirement includes one year of depreciation of the plant's total construction cost plus one year's return on investment on the undepreciated balance of plant cost. The second year's revenue requirement includes another year of depreciation plus another year's profit, etc. The revenue requirement for a capital item depends in part on the particular accounting rules used by the public utility commission and the tax laws in effect. Fuel and operating and maintenance (O&M) expenses form part of the revenue requirement in the year they are incurred. The revenue requirement also includes taxes, various overhead costs, and other miscellaneous items.

Real economic costs are measured by the actual outlays the utility makes for capital items, fuel, O&M, etc. Using the same example above (a plant built over five years and beginning operation in the sixth), the real economic cost of the plant consists of the stream of actual construction costs incurred over the first five years, and the stream of fuel expenses and O&M expenses incurred in year six and beyond. These costs are considered "real" in the sense that they measure the economic value of society's resources consumed in utility's operation. They are unaffected by accounting conventions or tax rates.

The electric rate perspective measures costs to one group, the utility's customers. The real economic cost perspective measures costs to society as a whole. In comparing supply alternatives for a utility, analyses from the two perspectives will often agree on which alternative is superior, but this is not always the case. Electric rates are determined in part by the vagaries of tax laws and regulatory decisions that shift costs among ratepayers, shareholders, and taxpayers, whereas real economic costs are unaffected by these factors. As demonstrated in a later section, the Settlement exhibits a large degree of such cost shifting.

II. CRITIQUE OF THE NEW YORK PSC RATE COMPARISON

The basis of the claim that the Settlement is less expensive than Shoreham operation is a PSC staff study entitled "Comparative Economics of Shoreham Settlement and Shoreham In-Service," dated April 14, 1989.1/ That study estimates the electric rates that would result from the Settlement and the rates that would result from Shoreham being placed in service. The PSC study did not estimate the real economic costs of the two options.

The Settlement scenario assumes that in the near term LILCO burns more oil and imports more power than in Shoreham In-Service, and, in the longer term, substitutes gas-fired plants and demand side management for the capacity that Shoreham would provide. The study estimates electric rates out to the year 2002, but focuses on the shorter time period of 1988 to 1998.2/ It concludes that the Settlement would result in lower rates and generally lower annual rate increases compared to Shoreham In-Service.

A series of varying utility rates is often summarized as a "levelized rate."3/ The PSC study estimates that the levelized electric rate resulting from the Settlement would be 13.89 cts/kWh for the period 1988-1998, compared with a rate of 14.46 cts/kWh for Shoreham In-Service. Rate increases would average 4.8% per year under the Settlement as opposed to 6.0% per year under Shoreham In-Service.

This evaluation of the PSC study drew on many sources of information: computer print-outs underlying the PSC study, discussions with PSC and LILCO staff, and discussions with experts in government, consulting firms, and industry. The evaluation concludes that the PSC study is a biased and unfair comparison of the Settlement vs. Shoreham In-Service, and that a proper comparison of the two options shows that operating Shoreham would be less expensive. Specifically, the evaluation reaches the following conclusions:

(A) The PSC study is fundamentally biased against Shoreham In-Service in its use of a short time horizon and its assumption of sharply different equity write-offs and capital structures for the two options.

(B) The comparison is unfair in that it does not hold constant two valued characteristics of a utility system: reliability and fuel diversity. Both are lower in the Settlement and thus the perceived cost of the Settlement is lower than it would be if the two alternatives were compared on an equal footing.

(C) The estimates of several specific cost factors involving capital, fuel, and other expenses are unreasonable. In every case, these estimates make the Settlement appear

to be the cheaper option.

The discussion below explains each of these points in detail. Note that some of the PSC assumptions are perfectly reasonable: inflation is assumed to be 4%; the discount rate is 10%; and Shoreham's capacity factor is assumed to be 65%.

A. FUNDAMENTAL BIASES

The PSC study has two fundamental biases: it focuses on a very short time horizon, and it assumes very different equity write-offs and capital structures for the Settlement vs. Shoreham In-Service scenarios. These assumptions bias the analysis against Shoreham In-Service regardless of more specific cost estimates concerning capacity costs, fuel prices, etc.

1. Time Horizon

The PSC study estimates levelized rates for the periods 1988-1998 and 1988-2002, but emphasizes its results for the former period. The levelized electric rates for the two scenarios are shown in the table below.

PSC ESTIMATES OF LEVELIZED ELECTRIC RATES 4/
(1988 cts/kWh)

Years	1988-1998	1988-2002
SETTLEMENT	13.89	14.44
SHOREHAM IN-SERVICE	14.46	14.96
SAVINGS FROM SHOREHAM IN-SERVICE	(0.57)	(0.52)

The levelized cost for the Settlement is estimated to be about 0.57 cts/kWh less expensive than Shoreham In-Service for the eleven-year period, 1988-1998. By simply extending the analysis four more years, the rate difference shrinks to 0.52 cts/kWh for the period 1988-2002.

This is not a surprising result. Investments in baseload plants are designed to be economic over utility planning horizons of at least 20-30 years. After all, these plants have lifetimes of 40 years or more. If a utility looked ahead only 11 years, it might never build a plant with a relatively high capital cost and low operating cost (e.g., a nuclear or coal plant). In the PSC's analysis, when the time horizon increases to 15 years, Shoreham In-Service becomes more economic. If the PSC had extended the time frame to the normal utility planning horizon, the rate difference would likely have narrowed further. In fact, the

PSC Chairman testified before the Energy Committee that studies indicated that Shoreham would be the less expensive supply option over its projected 40-year life.5/ For purposes of this evaluation, however, we will focus on the longest horizon available in the PSC study (i.e., 15 years) while noting that its relatively short length still biases the analysis against Shoreham In-Service.

2. Equity Write-Off and Capital Structure

The second fundamental bias in the PSC analysis is the assumptions regarding LILCO's equity write-off and capital structure in the two scenarios. First, the Settlement calls for a write-off of $250 million of investment in addition to the $1.4 billion disallowance that LILCO would face under either scenario.6/ A sure way to lower rates is to force shareholders to take a greater loss on their investment. However, the extra $250 million disallowance need not be unique to the Settlement. The Settlement would be an option with or without the extra disallowance, just as Shoreham operation could proceed with or without the extra disallowance.

This disallowance-related bias accounts for fully half of the rate difference between the two options as estimated by the PSC. The higher write-off of investment represents 0.26 cts/kWh of the 0.52 cts/kWh difference in the levelized rates of the Settlement and Shoreham In-Service.7/

Second, the Settlement analysis assumes three changes in LILCO's capital structure that compensate for what is described as the "lower risk" of the Settlement. The analysis assumes the following changes:

1) the cost of debt and equity both decline by 0.25% relative to Shoreham In-Service;

2) LILCO substitutes debt for equity, dropping its equity share from about 40% to 30%; and

3) LILCO refunds certain high coupon debt issues two years earlier under the Settlement.

Each of these changes in the capital structure leads to a lower revenue requirement in PSC estimate for the Settlement.

The PSC's assessment of the comparative risks is overdrawn. Shoreham In-Service carries certain risks, but the Settlement carries risks as well. They are not dramatically different. At most, there is a modest difference in how the financial community would perceive the risks of investing in LILCO under the two scenarios.

Financial analysts generally concur that an electrical

utility with a nuclear plant under construction carries some risk premium relative to a non-nuclear utility.8/ However, there is virtually no risk premium for a utility that simply operates a reactor relative to a non-nuclear utility.9/ The reason is straightforward: during the construction phase, the total cost of the plant is uncertain, as is the amount the regulators will allow into ratebase. Investors demand a risk premium under these circumstances. Once the plant is complete and ratemaking treatment is finalized, most of this risk disappears.

Nevertheless, there may be some risk premium if a plant turns out to be a lemon or faces continued opposition after full power start-up, e.g., Pacific Gas and Electric's Diablo Canyon plant. Perhaps one can make a case for up to a 0.25% risk premium for LILCO with Shoreham in service, as the PSC has assumed. However, there is no basis for making the additional compensations cited above (higher debt leveraging and early bond refunding) for the "lower risk" of the Settlement.

Consider first the substitution of debt for equity. With interest being deductible for tax purposes, a firm can reduce its after-tax cost of capital with a higher debt ratio. However, the increased leveraging of the company would tend to drive up the pre-tax cost of both debt and equity, while the PSC study assumes the pre-tax costs would decline. An equity ratio of only 30% would be unusual for a major electric utility. Equity ratios of 40% or greater are the norm in the industry. In fact, only 8 of 181 major electric utilities have equity ratios less than 35%.10/

Whatever the benefit of higher leverage may be, it need not be unique to the Settlement. The same holds true for the early refunding of high coupon debt. These extra compensations for "lower risk" ignore the fact that there are risks in the Settlement as well. Examples abound: the Nuclear Regulatory Commission must approve the transfer of the Shoreham operating license to LIPA, an action that is by no means assured. There are unresolved legal questions concerning NYPA's participation in the Settlement.11/ A number of parties have filed a suit in the New York state courts to block the Settlement.12/ Finally, a bill has been introduced in the House of Representatives (H.R. 2654) to prevent LILCO from taking a tax write-off if it sells Shoreham. It is also worth noting that any claim that the PSC has lowered LILCO's risk by giving 3 years of stable rate increases is spurious. Once again, this action need not be unique to the Settlement.

The risks of the Settlement are as hard to assess as those of Shoreham In-Service. The PSC claims that LILCO would bear an "asset concentration risk" if it operates Shoreham. The argument goes as follows: it is risky for a

firm to have too high a percentage of its total assets tied up in a single asset. If that asset fails to perform as intended, it could drag down the whole firm. Presumably, in LILCO's case, this means that if Shoreham turns out to be a lemon, the PSC might disallow cost recovery in the future.

This is another instance in which an argument that applies to Shoreham In-Service applies to the Settlement as well. First of all, the paper asset created by the Settlement would create a similar level of asset concentration as Shoreham In-Service. Moreover, some future PSC could disallow recovery of part of the $3.7 billion "paper asset" that the Settlement proposes to put in ratebase in lieu of Shoreham (a costly and ironic outcome), just as it could disallow part of the investment in Shoreham. Finally, as we will discover in a section below, LILCO's reliability would suffer under the Settlement. Thus there is some tangible risk that some future PSC might penalize the Company for allowing reliability to deteriorate.

The key point here is that the PSC assumption of a decline of 25 basis points in the cost of capital under the Settlement is plausible, though by no means certain. However, to propose further changes in capital structure to compensate for "lower risk" plainly constitutes a bias in the analysis.

If one corrects for the biases inherent in the PSC study regarding time horizon and capital structure, the rate difference between the Settlement and Shoreham In-Service narrows dramatically. Earlier we saw how a longer time horizon narrows the difference between the two options. The Settlement's estimated levelized rate goes up when one removes the biases of the higher write-off of investment (0.26 cts/kWh), the lower equity ratio (0.18 cts/kWh), and the delay in refunding high coupon debt (0.04 cts/kWh).13/ With these revisions, the rate difference between the Settlement and Shoreham In-Service narrows from 0.52 cts/kWh to 0.04 cts/kWh.

One final note on capital structure: the Rate Moderation Agreement that forms part of the Settlement assumes that LILCO would obtain a minimum of $100 million per year of Industrial Development Bonds for a minimum of five years.14/ The PSC cost comparison does not discuss these bonds, but clearly this is another instance in which the Commission is trying to lower the apparent cost of the Settlement through a financial device that has nothing to do with the relative merits of Shoreham vs. alternative sources of power.

B. FAILURE TO HOLD KEY FACTORS CONSTANT

We turn now to a second major flaw in the PSC study. The PSC cost comparison is unfair in that it does not hold

constant two valued characteristics of a utility system: reliability and fuel diversity. Both are lower in the Settlement and thus they decrease the perceived cost of the Settlement.

1. Reliability

Electric utilities aim to maintain high standards in the reliability of their service. They must have generating capacity in excess of peak demand in case any power plants fail, transmission service is interrupted, or customers demand more electricity than anticipated. Utilities set reliability criteria that aim to balance the benefits of reliable service and the costs of maintaining reliability through adequate generating and transmission facilities and demand side management.

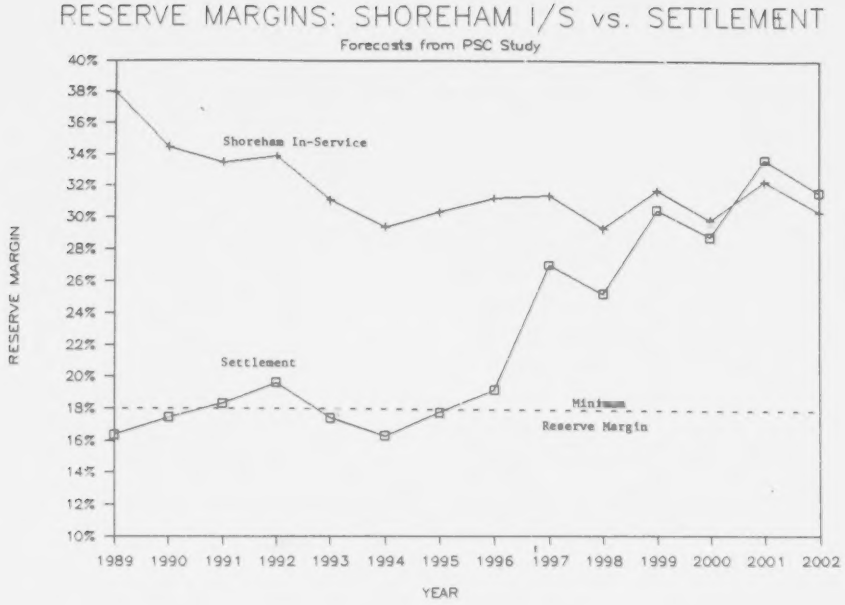
As a member of the New York Power Pool, LILCO must maintain a reserve margin of 18%, i.e., capacity must exceed peak demand by that percentage. In addition, LILCO aims to achieve a reliability level of no more than 3 voltage reductions per year. This objective translates to a reserve margin for Long Island as a whole of over 30% due to the Island's relative isolation.15/

Examination of the two supply plans underlying the Settlement and Shoreham In-Service reveals that the Settlement would lead LILCO to violate the bare minimum 18% reserve margin requirement in 5 of the next 7 years from 1989 to 1995. In contrast, Shoreham In-Service easily exceeds the target reserve margin from 1989 forward. Fig. 1 portrays the annual reserve margins projected in the two supply plans. Clearly, the Settlement leads to lower levels of reliability.16/ The Shoreham In-Service scenario would meet even the stricter 30% reserve margin in all but two years late in the study period (leaving time for corrective action, i.e., construction of more capacity). In contrast, the Settlement would fail to meet the stricter reliability standard for nearly all of the 1990's.

This conclusion is acknowledged in the PSC study: it concedes that reliability would be lower in the Settlement. The study is worth quoting at length:

> The energy plan for the Settlement does not assume the construction of sufficient capacity on Long Island to meet the near-term projected requirements. Between 550 MW and 1150 MW of capacity are assumed to be available for import from the New York Power Pool. Such an assumption may be feasible, but raises several questions which apparently were not addressed. 1150 MW approaches the maximum capacity of LILCO's share of the ties to Long Island. None of the upstate utilities has plans to construct capacity to sell to LILCO, so there is no

Fig. 1


RESERVE MARGINS: SHOREHAM I/S vs. SETTLEMENT
Forecasts from PSC Study
RESERVE MARGIN
40%
38%
36%
34%
32%
30%
28%
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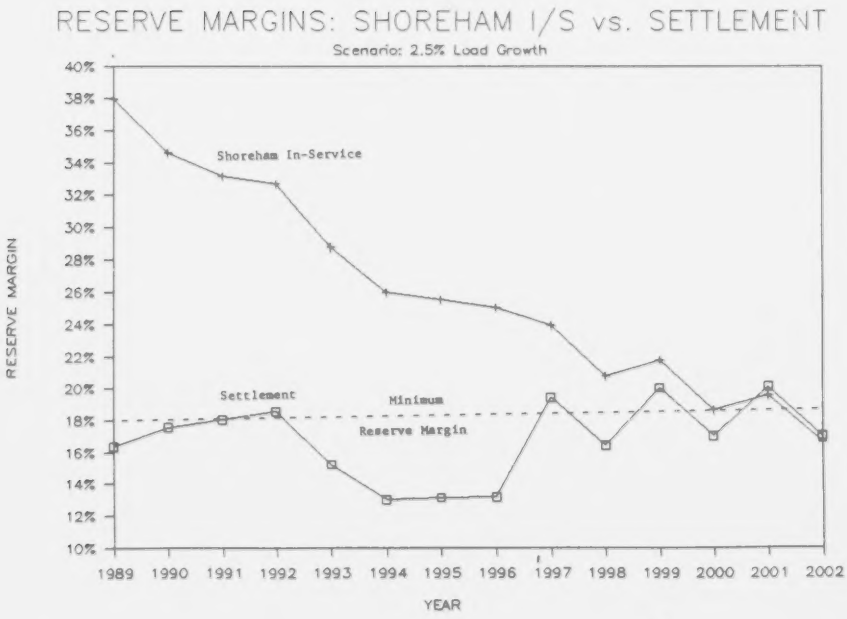
12%
10%
Shoreham In-Service
Settlement
Minimum
Reserve Margin
1989 1990 1991 1992 1993 1994 1995 1996 1997 1998 1999 2000 2001 2002
YEAR

Fig. 2


RESERVE MARGINS: SHOREHAM I/S vs. SETTLEMENT
Scenario: 2.5% Load Growth
RESERVE MARGIN
40%
38%
36%
34%
32%
30%
28%
26%
24%
22%
20%
18%
16%
14%
12%
10%
Shoreham In-Service
Settlement
Minimum
Reserve Margin
1989 1990 1991 1992 1993 1994 1995 1996 1997 1998 1999 2000 2001 2002
YEAR

> assurance that the capacity will be available for sale. If upstate loads continue to grow strongly, the upstate utilities may themselves need capacity earlier than past projections indicate. This could result in earlier construction of supply options on Long Island or the allocation of more Canadian power. Moreover, the import of 1150 MW will present a difficult operating problem caused by the potential loss of the transmission. It is also not clear in reviewing the technical tables that adequate funding was included for the capacity assumed to be available from upstate.17/

In short, the imported power the PSC is counting on may not be available, and if it is, it will strain the transmission capacity serving Long Island. Under the Settlement, LILCO's transmission links to neighboring utilities would be loaded at close to maximum levels, with reliability being crucially dependent on those lines operating without outages. LILCO's ability to import power during emergencies would be impaired and reliability would suffer.

The reliability outlook appears even worse under the Settlement when one examines the load growth assumptions that underlie it. The PSC study assumes that growth in peak demand will average just 1.6% per year from 1988-2002. Note that this forecast does not include demand side management--growth is assumed to be even lower with DSM. Load growth of 1.6% is low relative to the growth experienced so far in this decade. From 1980 to 1988, LILCO's average load growth was 2.5%.18/ Weather-normalized load growth was even higher, averaging over 3% per year. Weather-normalized growth in 1987 and 1988 was a brisk five to six percent. This record is similar to that of the Northeast in general which averaged 2.7% per year load growth in this decade so far.19/

Reliability would be even lower under the Settlement if load growth continues at its recent pace. Fig. 2 shows reserve margins for a load growth scenario of 2.5% per year. Under the Settlement, LILCO's margin falls below the minimum 18% in nine out of fourteen years. Naturally, reserve margins decrease for Shoreham In-Service as well, but they stay well above 18% for most of the 15-year period. Even if no other capacity is added, the reserve margin would not dip below 18% until 2002.

Demand growth is by nature uncertain, but the PSC study assumes very low load growth which tends to diminish the threat to reliability posed by the Settlement. The Shoreham In-Service scenario can maintain and exceed the required reserve margin in the face of higher, more likely load growth.

Though the PSC study concedes that reliability would be lower in the Settlement, it nevertheless cites "potential

reliability problems" that would be created by Shoreham's operation.20/ The study argues that an immature nuclear plant can strain the reliability of an electric system if it does not perform well. It cites the record of the Nine Mile Point 2 reactor as an example of poor performance by an immature plant.21/ One example, however, does not constitute an argument. The record of other plants coming on line in recent years is encouraging. A total of 31 plants have begun operation since 1983; their average capacity factor through 1988 is 68%. The average first year capacity factor for these plants is 64%.22/ This record does not suggest a high risk of chronic outages in the early years.

The PSC study also raises the specter of forced outages in mature plants, this time citing experience with Nine Mile Point 1. The relevance of this experience is questionable in light of the general improvement in capacity factors over the last decade. The average capacity factor for all U.S. reactors was 65% in 1988. Shoreham is a boiling water reactor. This type of reactor has had an average capacity factor of 64% since 1984. The risk of Shoreham being a poor performer is real but small. It is not fundamentally different from the other risks facing LILCO regarding load growth, the success of DSM programs, fuel availability, independent power producers, etc.

By not holding reliability constant, the PSC study makes the Settlement appear less expensive than it really would be. One way to adjust for this flaw is to add more capacity early in the Settlement scenario to boost its reserve margins up to an acceptable, comparable level. A plausible means of doing this is for the Settlement to include another 238 MW of combustion turbines in 1990, in addition to those added to both scenarios in 1989. This earlier capacity addition would probably eliminate the need for the third combined cycle plant planned for 2001. Fig. 3 shows the resulting reserve margin for the Settlement (and the unchanged reserve margin for Shoreham In-Service). Fig. 4 shows reserve margins for the same change in supply plan but assumes 2.5% load growth.

In Fig. 3, reserve margins in the Settlement are still well below those of Shoreham In-Service for most years, but they are comfortably above the minimum 18%. As Fig. 4 shows, with the added capacity in 1990, the Settlement could maintain an 18% reserve margin in the face of 2.5% load growth as well.

The addition of more combustion turbines to the Settlement supply plan is by no means a perfect adjustment for the disparity in reliability in the original PSC analysis. Other means are possible. One could estimate the benefit of additional reliability provided in Shoreham In-Service. Or one could devise a Settlement supply plan that would truly hold reliability constant, using a full-blown

Fig. 3

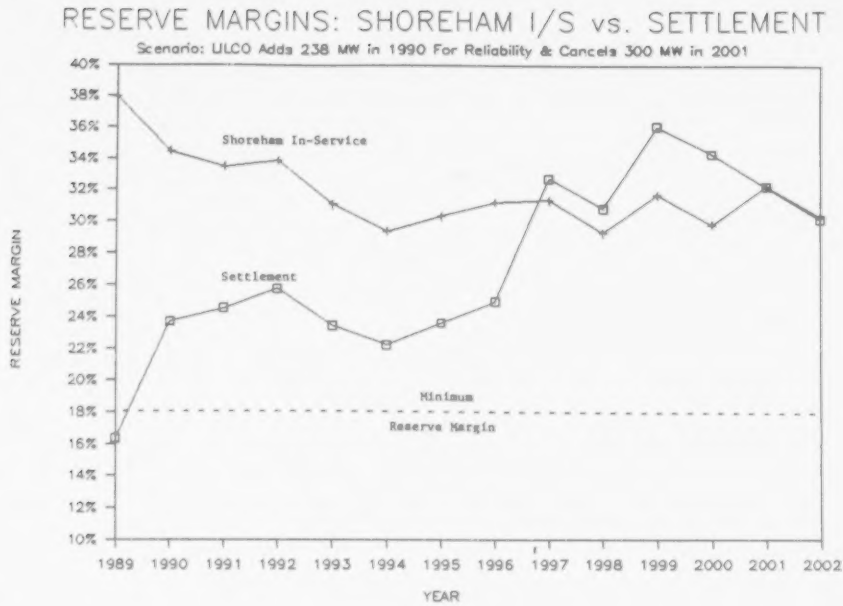
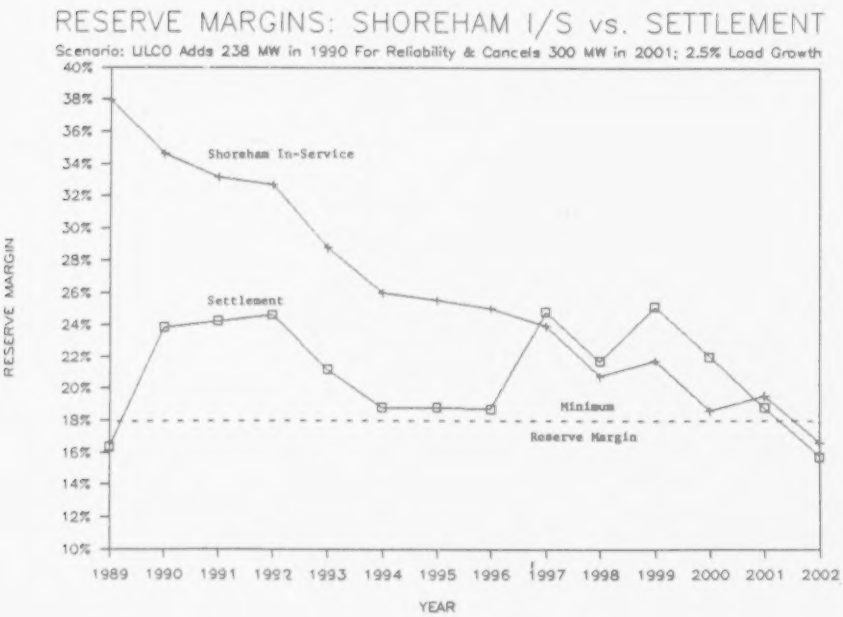

RESERVE MARGINS: SHOREHAM I/S vs. SETTLEMENT
Scenario: ULCO Adds 238 MW in 1990 For Reliability & Cancels 300 MW in 2001
RESERVE MARGIN
40%
38%
36%
34%
32%
30%
28%
26%
24%
22%
20%
18%
16%
14%
12%
10%
Shoreham In-Service
Settlement
Minimum
Reserve Margin
1989 1990 1991 1992 1993 1994 1995 1996 1997 1998 1999 2000 2001 2002
YEAR

Fig. 4


RESERVE MARGINS: SHOREHAM I/S vs. SETTLEMENT
Scenario: ULCO Adds 238 MW in 1990 For Reliability & Cancels 300 MW in 2001; 2.5% Load Growth
RESERVE MARGIN
40%
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Shoreham In-Service
Settlement
Minimum
Reserve Margin
1989 1990 1991 1992 1993 1994 1995 1996 1997 1998 1999 2000 2001 2002
YEAR

analysis of loss-of-load probabilities. Such an analysis might reveal that reserve margins could be somewhat lower in the Settlement than in Shoreham In-Service if several small units replace a single large unit such as Shoreham. Nevertheless, LILCO must at least meet its 18% reserve margin.

The adjustment offered here has the modest goal of allowing the Settlement to meet the 18% reserve margin requirement under the PSC load growth scenario and under a plausible 2.5% load growth scenario. The result is that the difference in reliability in the two scenarios narrows rather than remaining vastly different.

This adjustment in the Settlement supply plan would have an impact on electric rates. Building additional combustion turbines would increase rates beginning in 1990; cancelling a combined cycle plant slated for 2001 would decrease rates. The net effect would be to raise the levelized rate of the Settlement by 0.05 cts/kWh.23/

2. Fuel Diversity

There is a second valued characteristic of a utility system that is not held constant in the PSC study: fuel diversity. Diversity in fuels lowers the risk that any one event can have a dramatic effect on a utility's costs. Currently, LILCO is 100% dependent on oil and gas for power generation, with 75% of its capacity able to burn oil only. LILCO is extremely vulnerable to a sharp escalation in oil and gas prices and an oil supply disruption. The Settlement would not change this.

If Shoreham operates, LILCO's oil and gas dependence would drop to 83%.24/ The value of this increase in fuel diversity is hard to quantify, and no attempt to do so is made here. Nonetheless, the Settlement carries the hidden cost of maintaining LILCO's complete lack of fuel diversity.

C. COST ESTIMATION

The final flaw in the PSC study concerns cost estimation. The PSC study uses unreasonable estimates for several specific cost factors.25/ These include:

(1) nuclear O&M costs and capital additions,

(2) oil prices, and

(3) demand side management costs.

In every case, the unreasonable estimates used by the PSC help make the Settlement appear to be the cheaper option.

1. Nuclear O&M Costs and Capital Additions

The PSC study assumes Shoreham's operating and maintenance (O&M) costs to be $106 million in its first full year of operation. (All cost figures are in 1989 dollars unless otherwise noted.) The study argues that this figure is "within the wide range of expenditures experience at other single-unit sites" and is close to, though 20% higher than, the forecast for O&M at Nine Mile Point 2.26/ The estimate for Shoreham is equivalent to $129 per kilowatt in O&M cost.27/ This cost escalates at 1.8% (nominal) for most of the study years.

The current study evaluates this PSC assumption in light of three sources of information: recent O&M costs for nuclear plants, a Department of Energy (DOE) Task Force assessment of O&M costs for Shoreham, and an econometric model of O&M costs from a leading energy economics consulting firm.28/ The most recent year for which O&M cost data are available is 1987. O&M costs averaged 1.4 cts/kWh in that year,29/ or $85/kW for a reactor of Shoreham's size. The DOE recommends a cost estimate of $100/kW, substantially less than the PSC's estimate. National Economic Research Associates (NERA) maintains an econometric model of nuclear O&M costs.30/ The NERA model estimates Shoreham O&M costs of $114 per kW for the first year of commercial operation. By all of these standards the PSC estimate appears unreasonably high.

A number of factors should help stabilize O&M costs in the future. Much of the recent growth in O&M is linked to growth in plant staff. The average number of staff per plant doubled from 400 in 1981 to 800 presently. Security staff doubled from 90 in 1982 to 180 in 1985. There is no reason to expect this growth in staff to continue. Some growth in O&M costs is attributable to NRC-mandated design changes and economic and regulatory incentives for improved performance. There are indications that these factors have stabilized and hence they will not induce further growth in O&M.

Capital additions are major repairs and additions to nuclear plants that are put into ratebase rather than treated as an expense. The PSC study assumes Shoreham's capital additions to be $76 million in its first full year of operation. The study notes that capital additions, like O&M, can vary within a wide range, and that the assumption for Shoreham is higher than that for Nine Mile Point 2.31/ The estimate for Shoreham is equivalent to $93 per kilowatt in capital additions. This cost also escalates at 1.8% (nominal) for most of the study years.

The current study evaluates the PSC capital additions forecast in light of the same three sources of information listed above. In 1987, the most recent year for which capital addition data is available, the industry average was

$23/kW.32/ The DOE recommends a cost estimate of $64/kW, once again, substantially less than the PSC's estimate. NERA also maintains an econometric model of capital additions.33/ The NERA model estimates Shoreham capital additions of $63 per kW for the first year of commercial operation. Once again, the PSC estimate appears unreasonably high.

Shoreham has some characteristics that might lead one to think it will require relatively expensive capital additions. It is located in the Northeast where wage rates are high; it uses saltwater cooling; and it is a Boiling Water Reactor (BWR), the type that has experienced higher-than-average capital additions. On the other hand, Shoreham is a post-TMI reactor. The changes in design required in the wake of the accident at Three Mile Island have already been incorporated into the Shoreham reactor.

In contemplating the record of BWRs, it is important to account for the fact that Shoreham is a Mark II reactor. There are three distinct BWR containment designs: Mark I, II, and III. The implications for capital additions have been described well by William Hieronymus of Putnam, Hayes & Bartlett, an expert in utility economics:

> Mark I reactors were the first large-scale commercial designs by General Electric and they contained two significant generic flaws. The first was main recirculation pipe cracking due to intergranular stress corrosion cracking (IGSCC) which required replacement of these pipes. New welding techniques and IGSCC resistant pipe materials were incorporated in later Mark II and Mark III designs....
> The second contributor was torus containment modifications. These NRC-mandated backfits were in response to information showing possible structural damage to the torus in the event of steam injection as the result of an accident. The later Mark II design had similar steam-injection concerns raised at the same time, but since none were operational at the time and modifications were completed prior to startup, their costs were included in the initial cost of the plant....
> BWRs have had higher capital additions that PWRs and capital additions have increased with time and/or plant age, taking the 1970 to 1985 period as a whole. However,... to the extent we can learn from the historic data, the BWR problem is unique to Mark I reactors.34/

Indeed, the historic data support the notion that Mark II reactors will have significantly lower capital additions than BWRs as a whole. For the period 1981-1987, BWR's had capital additions averaging $35/kW per year. The average for Mark I reactors was $47/kW, while the average for Mark II reactors was only $20/kW.

There is another reason to expect Shoreham capital additions to be relatively low, namely, "finishing construction costs." In the Shoreham In-Service scenario, LILCO continues to make improvements and modifications on the plant prior to full power operation, spending $243 million and $110 million in 1988 and 1989 for finishing costs. Some of these costs might otherwise become capital additions in later years.

The rate for Shoreham In-Service decrease if one uses more realistic assumptions concerning O&M costs and capital additions. The estimates cited above based on the NERA models and from DOE are conservative in that they are significantly above industry averages. When the NERA or DOE estimates replace the PSC assumptions, the levelized rate for Shoreham In-Service decreases by 0.12 and 0.15 cts/kWh, respectively. The leveling off of these costs in recent years is reason for a guarded optimism about the industry's ability to keep these costs manageable in the future, hence this study adopts the higher DOE figure. Shoreham In-Service is the economic alternative using either figure.

2. Oil Prices

Oil prices play a crucial role in the economics of Shoreham. If Shoreham were to operate, LILCO would cut back its oil-fired generation substantially. The PSC study uses a very low oil price forecast, and thus the fuel savings from Shoreham In-Service are underestimated.

The PSC's forecast begins with a price of $2.35/MMBTU in 1988 for residual fuel oil (or $14.51/bbl).35/ Real price escalation (i.e., above inflation) is assumed to be 0% real through 1993 and 2% thereafter. This forecast is far below the PSC's own price forecast made less than a year earlier in the Commission's Long Run Avoided Cost (LRAC) proceeding. That forecast assumed the real price escalation would be 1.5% through 1994, 4% in 1995, and 6.5% thereafter.36/ Fig. 5 displays graphically the difference in the resulting price trajectories. The lowest line on the graph shows the PSC forecast used in the Shoreham analysis, expressed in 1988 dollars per MMBTU. The top line shows the LRAC forecast made in 1987. The middle line shows a modified LRAC forecast that uses the 1988 starting point of the Shoreham analysis and applies the LRAC escalation rates. The oil price forecast used in the Shoreham analysis is far below either LRAC forecast.

The PSC forecast is also far below those of other leading forecasting organizations. Fig. 6 displays recent oil price forecasts from the Energy Information Administration37/, Data Resources, Inc. (DRI)38/, and the WEFA Group.39/ The PSC forecast is the lowest of the four shown by a wide margin.

Fig. 5

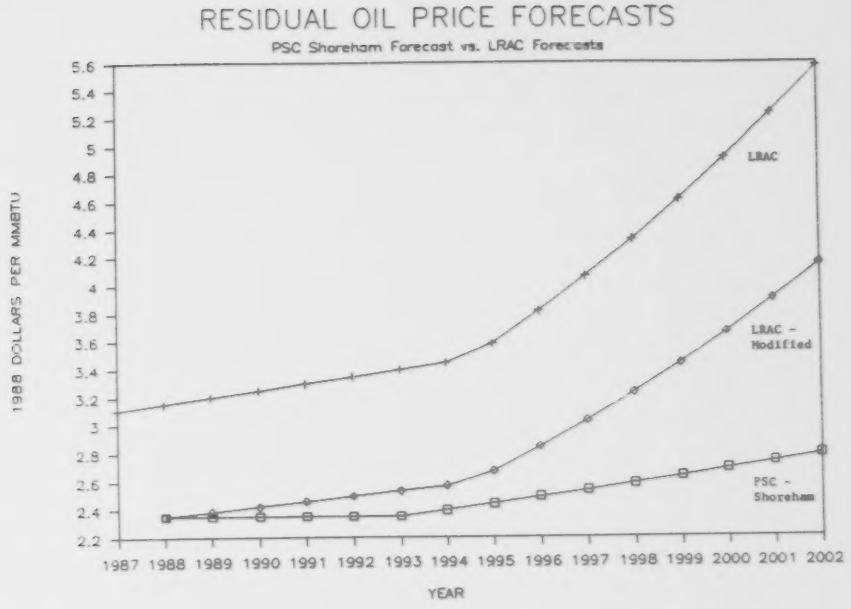
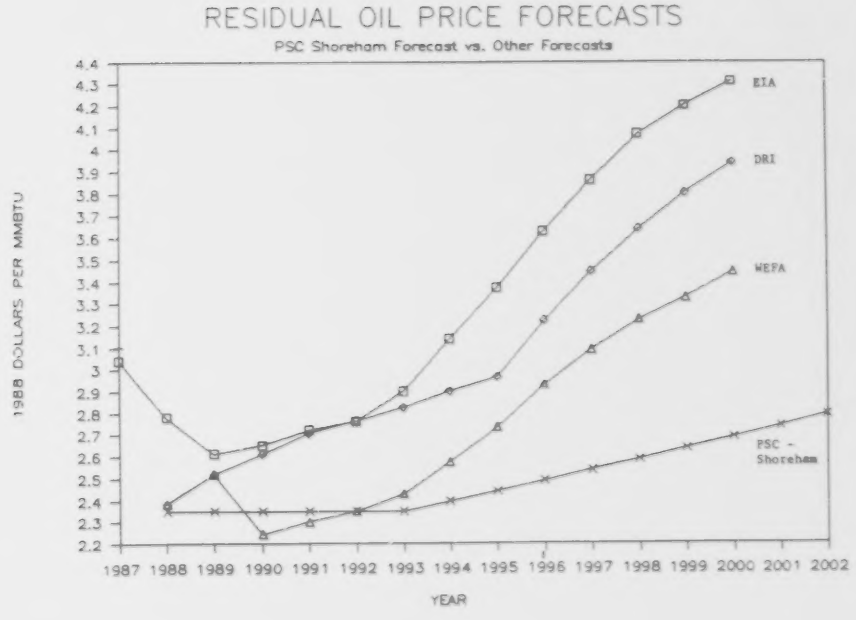

RESIDUAL OIL PRICE FORECASTS
PSC Shoreham Forecast vs. LRAC Forecasts
1988 DOLLARS PER MMBTU
YEAR
LRAC
LRAC - Modified
PSC - Shoreham

Fig. 6


RESIDUAL OIL PRICE FORECASTS
PSC Shoreham Forecast vs. Other Forecasts
1988 DOLLARS PER MMBTU
YEAR
EIA
DRI
WEFA
PSC - Shoreham

The comparison above indicates that the PSC uses an unreasonably low oil price forecast in its rate comparison. A more defensible approach would be to use a forecast in the middle of the range of estimates made by various organizations. The forecast by DRI is a logical candidate for this role. When the DRI oil price forecast is used in the rate comparison, it increases rates for both the Settlement and Shoreham In-Service, but the rate increase is higher in the Settlement due to the larger volume of oil burned. The increase in levelized rates is 0.54 cts/kWh and 0.40 cts/kWh for the Settlement and Shoreham In-Service, respectively.

3. Demand Side Management

The cost estimates for the "aggressive" demand side management (DSM) program called for in the Settlement are puzzling and may lead to a substantial underestimation of the costs of the Settlement. The aggressive program appears to reduce load growth at a far cheaper cost (measured in dollars per kilowatt) than the "base" DSM plan common to both scenarios.

The "base" DSM plan costs about $11 million in 1988 and escalates at inflation. It produces 20 MW of conservation. The Settlement assumes about $30 million per year of additional money which ultimately produces an additional 280 MW of conservation. The table below presents the average cost per kilowatt of the aggressive and base DSM plans. The costs are averaged over two periods: 1988-2002 and 1990-2002. The latter period is presented because of some anomalies in the 1988-1989 period (i.e., no incremental load reduction from the aggressive DSM plan and reductions greater than 20 MW in the base plan).

AVERAGE COST PER KW OF DEMAND SIDE MANAGEMENT

	1988-2002	1990-2002
Base DSM	$525	$761
Aggressive DSM	$158	$146

As the table illustrates, base DSM is assumed to be three to five times as expensive as aggressive DSM. Calculation of levelized costs per kW gives similar results.

The puzzling aspect of this is that the aggressive program appears to get far more bang for the buck. One would expect the reverse, namely, that the base program would achieve the least costly DSM measures, and the aggressive program would move up the supply curve of conservation and achieve some more costly measures. It is beyond the scope of this study to fully assess the reasonableness of the PSC

assumptions. On the surface it appears that the Commission has adopted an extremely optimistic estimate of DSM costs.

4. Miscellaneous

A minor but troubling flaw in the PSC analysis is the improper specification of the "book life" of two investments (i.e., the number of years over which the investment is amortized).40/ In the Settlement, the book life of the gas turbine (on-line in 1990) and the gas refiring project were set at 40 years, rather than 25 years. This error leads to a relatively low revenue requirement in the period 1988-2002 because the investment is recovered over a longer than normal period. For Shoreham In-Service, the book life of the same gas plant is set at 15 years, and the opposite effect occurs: the revenue requirement is higher than it should be. Correcting these errors leads to an increase of 0.01 cts/kWh for the Settlement and a decrease of 0.01 cts/kWh for Shoreham In-Service. One hopes that any remaining, undetected errors in the PSC analysis are not significant and are neutral in their effect on the rate comparison.

A final modification to the PSC analysis concerns decommissioning costs in the Shoreham In-Service scenario. The PSC notes that its estimate did not include an external fund for decommissioning as recently ordered by the NRC and thus the In-Service rate estimate would be low.41/ The current study corrects for this by accounting for a decommissioning accrual account. The result is an increase of about 0.01 cts/kWh in the levelized rate for Shoreham In-Service.42/

5. Conclusion

This section has demonstrated the many flaws in the PSC analysis. When these flaws are corrected, Shoreham operation is projected to be the less expensive option. The table below summarizes the effects of correcting the biases and unreasonable assumptions in the PSC study. The revised estimates of levelized electric rates for the Settlement and Shoreham In-Service are 15.51 and 15.22 cts/kWh, respectively, hence Shoreham In-Service would be 0.29 cts/kWh less expensive.

ESTIMATES OF LEVELIZED ELECTRIC RATES, 1988-2002 43/
(1988 cts/kWh)

	Settle-ment	Shoreham In-Service
ORIGINAL PSC ESTIMATES	14.44	14.96
Adjustments re capital structure		
Higher write-off of investment	.26	
Lower equity ratio	.18	
Delay in refunding high coupon debt	.04	
Additional gas turbines for reliability	.04	
Lower nuclear O&M and capital additions		(.15)
Higher oil prices	.54	.40
Correction in book life of investments	.01	(.01)
Decommissioning accrual account		.01
REVISED ESTIMATES	15.51	15.22
SAVINGS FROM SHOREHAM IN-SERVICE		.29

Note: Totals do not add due to rounding.

Viewed from the perspective of levelized rates, the differences between the two scenarios may seem small according to both the PSC's original estimates and the revisions presented here. The reader should keep in mind, however, that significant cost differences between operating Shoreham and turning to alternative power sources are masked by the fact that LILCO's overall revenue requirement is very large, encompassing the costs of its other generating plants, purchased power, the transmission and distribution system, and other general expenses. A sharper contrast between the two scenarios is drawn in the next section.

III. THE REAL ECONOMIC COSTS OF SHOREHAM

We turn now to the real economic costs (or economic opportunity costs) of Shoreham vs. the Settlement. Real economic costs are measured by the actual outlays the utility makes for capital items, fuel, O&M, etc. As an example, consider a plant built over five years and beginning operation in the sixth. The real economic cost of the plant consists of the stream of actual construction costs incurred over the first five years, and the stream of fuel expenses and O&M expenses incurred in year six and beyond. These costs are considered "real" in the sense that they measure the economic value of society's resources consumed in utility's operation. They are unaffected by accounting conventions or tax rates.44/

In the electric rate analysis just concluded, the focus was on how the Settlement or Shoreham In-Service would affect LILCO's overall electric rates. The effects seemed small because they were averaged in with all of LILCO's other costs. A better sense of the relative costs of the two options can come from comparing the cost of the increment of power supplied by Shoreham to the cost of supplying that power by the alternatives under the Settlement. The PSC study did not perform this analysis, and it was beyond the scope of the current study to conduct such an analysis in terms of electric rates and revenue requirements. However, the real economic costs of Shoreham's incremental power and its alternative are analyzed here.

Much of the two supply plans are identical. An incremental analysis focuses on those costs unique to each supply plan. The period of analysis is the same as before, 1988-2002. The annual real economic costs are summarized by taking their present value discounted to 1988 at a rate of 10%.

Let us turn first to a comparison of the real economic costs of the Settlement and Shoreham In-Service according to the PSC's original assumptions. To review for a moment, the Settlement would have LILCO pay for decommissioning the reactor, meet near-term needs with increased oil-fired generation and purchased power, build combined cycle plants in the late 1990s, pursue aggressive DSM, and undertake several other miscellaneous projects.45/ Shoreham In-Service would have LILCO incur the cost of O&M and capital additions for the reactor, pay for nuclear fuel costs, and build gas turbines in the late 1990s. For reasons unknown, the PSC includes a coal plant due on-line in 2010 in the Shoreham In-Service supply plan. It begins construction in 2001 and thus appears below in the PSC estimate.46/ All remaining LILCO costs are common to both supply plans. The unique costs of each option are listed in the table below.

The present value of each cost vector (using PSC assumptions) appears in the middle column.

PRESENT VALUE OF REAL ECONOMIC COSTS
(Millions of 1988 dollars)

SETTLEMENT	Using PSC Assumptions	Revised Estimate
Shoreham Decommissioning	381.4	381.4
Fossil Fuel and Purchased Power	735.3	924.3
"High Production" O&M Costs	23.7	23.7
Combined Cycle Plants - Construction	494.4	387.6
Combined Cycle Plants - O&M	48.8	48.8
Gas Turbines - Construction	n.a.	74.0
Aggressive Demand Side Management	242.4	242.4
Misc. Capital Spending	96.9	96.9
Total	2022.7	2179.1
SHOREHAM IN-SERVICE		
Shoreham O&M and Capital Additions	1687.9	1158.1
Gas Turbines - Construction	89.4	89.4
Gas Turbines - O&M	6.4	6.4
Coal Plant - Construction	11.6	n.a.
Nuclear Fuel	177.7	177.7
Total	1972.9	1431.6
SAVINGS FROM SHOREHAM OPERATION	49.8	747.5

Note: totals may not add due to rounding.

As the table indicates, the real economic cost of Shoreham In-Service, using the PSC's own numbers, is $50 million less than the Settlement (a difference of about 3%). The numbers change dramatically when the cost estimates are revised to correct for the biases and unreasonable assumptions discussed in Section II. The revised costs appear in the right-hand column above. To summarize, the revisions are as follows: The higher fossil fuel and purchased power cost reflects the DRI oil price forecast. The lower construction cost for combined cycles reflects the cancellation of the third plant. Gas turbine construction costs appear for a plant brought on-line in 1990 for increased reliability. The range of numbers for Shoreham O&M and capital additions reflect the estimates from DOE. The coal plant is dropped. There is no discernible reason why it is in Shoreham In-Service but not in the Settlement.

The revised estimates show that operating the Shoreham plant is far less expensive that abandoning it, saving three-quarter billion dollars or more on a present value basis. In

relative terms, it would save more than a third of the cost of the alternative.

These revised estimates are conservative in many respects and give the benefit of the doubt to the Settlement. The time horizon of the analysis is still relatively short (15 years) when a period of 20-30 years would be more appropriate. Reliability is still lower in the Settlement as discussed in Section II. No value is assigned to the improvement in fuel diversity for Shoreham In-Service. An increase in oil prices is assumed to have no effect on purchased power costs when, in fact, there would be some effect.47/ Finally, the PSC assumptions on the cost of DSM programs are accepted as is, though it seems likely that they underestimate the true cost.48/

IV. COST SHIFTING

A final aspect of the PSC study that is worth discussing is the phenomenon of cost shifting. To a large extent, the Settlement would not so much save costs as merely shift them on to various parties. The most obvious instance of this is the extra equity write-off that LILCO shareholders lose in the Settlement. Shareholders get a paper asset put in ratebase that is worth $250 million less than the prudent costs of Shoreham. This is not a reduction in costs; it is merely a shifting of costs from ratepayers to shareholders.

Taxpayers would receive similar treatment under the Settlement. According to PSC estimates, LILCO would pay far fewer taxes under the Settlement, and consequently taxpayers would either pay higher taxes or receive lower levels of government services. The PSC projects that Federal tax revenues would decline roughly $700 million (present value, 1988-2002). Property and miscellaneous taxes would also decline.

There are more subtle forms of cost shifting as well. The decline in LILCO's reliability under the Settlement would affect neighboring utilities, not just LILCO itself. All other things being equal, if any member of a power pool increases its demand for bulk power and transmission capacity, the reliability of all the interconnected utilities declines. From a national perspective, the Settlement would shift costs to the nation as a whole. LILCO would increase purchases of imported oil, thereby aggrevating the nation's trade deficit and energy security problems.

In sum, power from Shoreham will not come cheaply, but it will still be less costly than oil-fired generation, power imports, and the construction of replacement capacity. The New York PSC's cost comparison is flawed. An objective assessment of costs shows Shoreham In-Service to be the more economic alternative.

NOTES

1. The PSC also provided the Energy and Natural Resources Committee with what appear to be executive summaries of two comparative cost studies by Lazard Freres. Those studies reached conclusions similar to those of the PSC study.

2. Apparently much of the PSC analysis was conducted in 1988 rather than 1989.

3. Levelization accounts for the time value of money by taking the present value of a series of varying rates and calculating a "levelized rate" that, if held constant for the same number of time periods, would have the same present value as the original series of varying rates.

4. New York Public Service Commission (PSC), Staff Report, "Comparative Economics of Shoreham Settlement and Shoreham In-Service," April 14, 1989, p. 2. The main body of this report has page numbers appearing at the bottom of each page. The report begins with a 3-page summary. These pages will be referred to as S-1, S-2, and S-3 in citations below.

5. Peter A. Bradford, Chairman, New York PSC, Prepared Testimony before the U.S. Senate Committee on Energy and Natural Resources, April 13, 1989, p. 8.

6. PSC, Ibid., p. 3.

7. Ibid., p. 2.

8. See, for example, Berry K. and S. Loudenslager, "The Impact of Nulcear Power Plant Construction Activity on the Electric Utility Industry's Cost of Capital," Energy Journal, April 1987, 8(2):63-75.

9. This is the consensus view of several academic researchers and Wall Street analysts interviewed as part of this evaluation.

10. Energy Information Administration, Financial Statistics of Selected Electric Utilities 1987, DOE/EIA-0437(87), January 1989, Table 43. This tabulation excludes small utilities engaged only in generation or transmission.

11. Wall Street Journal, "Intent to Save Shoreham Plant Signaled by U.S.," June 6, 1989, p. B4.

12. Citizens for an Orderly Energy Policy, Inc. et al v. Cuomo et al (NYSC (Albany) No. 2481-89, filed May 26, 1989).

13. The rate adjustments listed here are from PSC, Ibid., p. 2.

14. Rate Moderation Agreement, Exh. 610, Case 29484 before the New York PSC, p. 2, footnote 1.

15. LILCO response to information request by author, May 1989.

16. The Chairman of the PSC presented a new load forecast and supply plan for the Settlement in his testimony at a hearing before the Senate Energy Committee in April 1989. The new forecast and supply plan are different from those underlying the rate comparison evaluated here, but no updated rate comparison was offered. Committee staff evaluated the existing rate comparison and its corresponding load forecast and supply plan in order to avoid an "apples and oranges" comparison. The staff would welcome an opportunity to examine an updated rate comparison if one becomes available.

17. PSC, Ibid., p. 9.

18. Percentages cited here are derived from load growth records supplied by LILCO.

19. Arthur Anderson & Co. and Cambridge Energy Research Associates, Electric Power Trends, 1989, p.22.

20. PSC, Ibid., p. S-2.

21. According to staff at the Congressional Research Service, Nine Mile Point 2 had a 28% capacity factor in its first 13 months of operation.

22. Capacity factor averages are based on data from the Nuclear Regulatory Commission, as provided to staff by the U.S. Council on Energy Awareness.

23. This rate increase estimate and those that follow are approximate. They are based on a staff revenue requirement model which does not perfectly replicate the more detailed financial model used in the PSC analysis. The estimate at hand is conservative in that it does not account for the fact that the combustion turbine would have a higher heat rate than a combined cycle plant and hence fuel costs would be higher, and that O&M costs would begin earlier, i.e, in 1990 rather than 2001.

24. Shoreham would represent 820 MW of a total capacity of 4902 MW (3842 MW of existing capacity, 240 MW of new combustion turbines coming on line in 1989, plus Shoreham's capacity).

25. The PSC study used a single set of assumptions and arrived at a single set of cost estimates for the Settlement and Shoreham In-Service. Whenever one uses a "single-scenario" approach such as this, the assumptions must be chosen with extreme care. Each assumption must reflect the analyst's assessment of the most likely value a particular cost factor will represent in the future. The alternative is a "multiple-scenario" analysis that examines a range of values for various cost factors in an effort to account for uncertainty and risk. This alternative would clearly be a preferable means of comparing the scenarios, but is beyond the scope of the present analysis. The previous section paid some service to the multiple-scenario approach in looking at a second, very plausible load growth assumption. Some of the PSC assumptions might be plausible in a multiple-scenario analysis but are not suitable for a single-scenario analysis.

26. PSC, Ibid., p. 6.

27. The dollars per kilowatt figure is derived as follows: $109.8 million in total O&M cost divided by 820 MW, divided by 1.04 for inflation.

28. This study evaluates the reasonablesness of PSC assumptions in light of average costs for both O&M costs and capital additions. Averages, however, lead one to overestimate what these costs might be at a particular plant (holding all else equal). Averages are somewhat misleading because typically the average is less than the median for O&M and capital additions, i.e., the distribution is skewed to the right. The costs for any given plant are likely to be closer to the median than the average.

29. Average O&M costs are based on data from FERC Form 1 as provided to staff by the U.S. Council on Energy Awareness.

30. NERA, "Analysis of Nuclear Plant Operating and Maintenance Costs and Post-Commercial Capital Additions," White Plains NY, 1988.

31. PSC, Ibid., p. 6.

32. Average capital addition costs are based on data from FERC Form 1, as provided to staff by the U.S. Council on Energy Awareness.

33. NERA, Ibid.

34. Putnam, Hayes & Bartlett, "Rebuttal Testimony of William H. Hieronymus," Penn Power Statement No. 9-R, Docket No. R-870732, December 1987, pp. 42-44, passim.

35. The price cited is for 1% sulfur oil delivered to Northport as listed in a table of oil prices provided by the PSC to the author.

36. PSC, "Staff Report on Long-Run Avoided Costs," Cases 28962, 28793, and 28689, October 27, 1987, Section F.

37. Personal communication from Robert T. Eynon, Energy Information Administration (EIA), June 12, 1989. The prices in the figure are for high-sulfur residual fuel oil delivered to utilities in the New York/New Jersey region. This forecast was made in the preparation of EIA, Electricity Generation from Natural Gas: Prospects and Implcations for the U.S., SR/EPD/89-01, January 1989. The EIA forecast for the national average residual fuel price in the Annual Energy Outlook 1989 was even higher.

38. The prices shown are for oil delivered to electric utilities in the Middle Atlantic region as projected in DRI/McGraw-Hill Energy Review, Spring 1989, Table A-30, converted to 1988 dollars using the GNP deflator in Table A-11.

39. The prices shown are based on the forecast of refiner's acquisition cost of crude oil from WEFA Group, Winter 1989 Energy Analysis Quarterly, p. 7.46, converted to 1988 dollars using the GNP deflator from p. 1.6.

40. This error was confirmed and discussed with the PSC staff.

41. PSC, Ibid., p. ES-3

42. This estimate is based on projections of the revenue requirement for a decommissioning accrual account provided to the author by LILCO.

43. PSC, Ibid., p. 2. and author's workpapers.

44. This discussion of real economic costs does not imply that utilities can or should seek to minimize real economic costs. One expects utilities to maximize profit or perhaps to minimize the revenue requirement for a given level of service. Nevertheless, in the absence of massive distortions in the market, utility behavior will be will fairly consistent with minimization of real economic costs. The Shoreham Settlement is an attempt to pointedly lead a utility away from the most economic supply plan.

45. These projects are labeled as follows in the appendix to the PSC study: Northport Capitalization, Gas Firing, Force Cooling, Capaciter Program, and Pilot Cable.

46. The coal unit was not discussed in Section II because it would have no effect on electric rates in the period 1988-2002, being under construction for the last two years of that period.

47. For example, LILCO currently buys power from NYPA's oil-fired Poletti plant. Higher oil prices would also increase demand for non-oil-based bulk power sales, and thus would likely lead to some price increases for those sales.

48. It is assumed here that the DSM costs are composed entirely of real economic costs (capital and operating costs) and do not include "incentive" payments that are transfers among ratepayers rather than real economic costs. To the extent such payments are included, the real economic costs of DSM presented here are overstated.

CHANGE IN LEVELIZED RATES - WORKPAPERS

LEVELIZATION CALCS		1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
** REL-Y ADJ: ADD CT, SUBTRACT CC ** [o/s]																
RR of 238 MW CT, 1990		0.0	0.0	18.2	16.9	15.9	15.0	14.4	13.7	13.2	12.6	11.8	11.2	10.6	10.0	9.4
RR of 300 MW CC, 2001		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	69.8	66.7
Net RR		0.0	0.0	18.2	16.9	15.9	15.0	14.4	13.7	13.2	12.6	11.8	11.2	10.6	-59.8	-57.3
Ave Rate Incr [/kWh]		0.00	0.00	0.12	0.11	0.10	0.09	0.09	0.08	0.08	0.07	0.07	0.06	0.06	-0.32	-0.30
NPV of Incr	0.3482															
Lvl Rate Incr	0.0416															
** CHANGE O&M PER DOE**																
PSC O&M	from kad	0.0	68.5	109.8	110.2	110.6	110.9	113.0	115.1	117.1	119.3	121.4	123.5	125.6	127.7	129.8
DOE O&M	from kad	0.0	41.0	85.3	88.7	92.2	95.9	99.8	103.8	107.9	112.2	116.7	121.4	126.2	131.3	136.5
RR Decr from lower O&M		0.0	-27.5	-24.5	-21.5	-18.4	-15.0	-13.2	-11.3	-9.2	-7.1	-4.7	-2.1	0.6	3.6	6.7
Ave Rate Incr [/kWh]		0.00	-0.18	-0.16	-0.13	-0.11	-0.09	-0.08	-0.07	-0.05	-0.04	-0.03	-0.01	0.00	0.02	0.03
NPV of Incr	-0.6366															
Lvl Rate Incr	-0.0761 [i/s]															
** CHANGE KADDS PER DOE**																
PSC KADDS		0.0	0.0	5.1	20.9	36.5	49.8	63.0	75.5	88.4	101.2	112.3	124.5	137.3	149.8	161.8
DOE KADDS		0.0	0.0	5.1	15.2	25.0	34.7	45.0	55.2	65.9	76.8	86.6	97.6	109.4	121.3	133.2
RR Decr from lower KADDS		0.0	0.0	0.0	-5.7	-11.5	-15.2	-17.9	-20.3	-22.5	-24.4	-25.7	-26.9	-27.9	-28.5	-28.7
Ave Rate Incr [/kWh]		0.00	0.00	0.00	-0.04	-0.07	-0.09	-0.10	-0.12	-0.13	-0.14	-0.14	-0.14	-0.15	-0.15	-0.15
NPV of Incr	-0.5982 [i/s]															
Lvl Rate Incr	-0.0715															
** INCR IN FUEL COST FROM DRI **																
Incr in o/s Fuel Cost		0.0	28.0	45.6	60.8	49.8	62.1	69.8	76.1	117.6	146.4	188.7	220.1	255.8	307.6	377.7
Ave Rate Incr [/kWh]		0.00	0.18	0.29	0.38	0.31	0.38	0.41	0.44	0.68	0.83	1.05	1.20	1.37	1.63	1.96
NPV of Incr	4.5111 [o/s]															
Lvl Rate Incr	0.5392															
Incr in i/s Fuel Cost		0.0	21.6	31.7	47.3	36.4	45.9	52.3	56.6	85.6	112.5	138.5	168.6	197.4	249.2	301.0
Ave Rate Incr [/kWh]		0.00	0.14	0.20	0.29	0.22	0.27	0.31	0.32	0.48	0.62	0.75	0.90	1.04	1.29	1.53
NPV of Incr	3.3769 [i/s]															
Lvl Rate Incr	0.4036															

CHANGE IN LEVELIZED RATES - WORKPAPERS

LEVELIZATION CALCS	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
** ADJUST FOR PSC ERROR IN BOOK LIFE **															
RR-CT 40 YR	0.0	0.0	17.9	16.8	15.9	15.2	14.8	14.3	13.8	13.4	12.8	12.4	11.9	11.5	11.0
RR-CT 25 YR	0.0	0.0	19.3	18.1	17.1	16.2	15.6	15.0	14.5	13.9	13.2	12.6	12.0	11.4	10.8
RR-CT 15 YR	0.0	0.0	21.8	20.3	19.1	18.0	17.2	16.4	15.6	14.8	13.8	13.0	12.2	11.4	10.5
RR-GAS 40 YR	0.0	0.0	0.0	8.2	7.6	7.2	6.9	6.7	6.4	6.2	6.0	5.8	5.5	5.4	5.1
RR-GAS 25 YR	0.0	0.0	0.0	8.8	8.2	7.7	7.3	7.1	6.8	6.5	6.3	5.9	5.7	5.4	5.1
Incr O/S, CT	0.0	0.0	1.4	1.3	1.1	1.0	0.9	0.8	0.6	0.5	0.4	0.2	0.1	-0.1	-0.2
Incr O/S, GAS	0.0	0.0	0.0	0.6	0.6	0.5	0.4	0.4	0.3	0.3	0.2	0.2	0.1	0.0	0.0
Total Incr, O/S	0.0	0.0	1.4	1.9	1.7	1.5	1.3	1.1	1.0	0.8	0.6	0.4	0.2	0.0	-0.2
Decr I/S, CT	0.0	0.0	-2.5	-2.2	-2.0	-1.8	-1.6	-1.3	-1.1	-0.9	-0.7	-0.4	-0.2	0.1	0.3
Ave Rate Incr, O/S	0.00	0.00	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.00	0.00	0.00	0.00	0.00	0.00
Ave Rate Decr, I/S	0.00	0.00	-0.02	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01	0.00	0.00	0.00	0.00	0.00	0.00

NPV of Incr, O/S 0.0433
Lvl Rate Incr 0.0052 [o/s]
NPV of Decr, I/S -0.0545
Lvl Rate Decr -0.0065 [i/s]

** DECOMM ACCRUAL **															
Incr in Decomm Accrual [i/	0.0	1.2	1.2	1.4	1.4	1.4	1.5	1.5	1.5	1.7	1.7	1.7	2.0	2.0	2.0
Ave Rate Incr [/kWh]	0.00	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01

NPV of Incr 0.0639 [i/s]
Lvl Rate Incr 0.0076

REAL ECONOMIC COST - WORKPAPERS

	NPV	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
** PSC ESTIMATES **																
SETTLEMENT																
Shoreham Decomm	381.4	149.7	54.6	37.9	71.4	75.5	46.0	30.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Fos Fuel & Purch Powe	735.3	0.0	53.6	101.3	74.1	99.8	108.4	102.5	111.5	131.3	99.8	149.5	119.0	121.9	89.8	109.4
High Prod O&M	23.7	0.0	2.1	4.5	4.7	3.9	4.1	4.3	4.5	4.7	2.0	2.1	2.2	0.0	0.0	0.0
CC - Construction	494.2	0.0	0.0	0.0	0.0	0.0	0.0	5.4	88.0	198.9	106.4	219.3	117.1	241.7	129.1	258.6
CC - O&M	48.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	11.4	11.9	24.7	25.7	40.0	41.6
GT - Construction																
Aggres DSM	242.4	10.5	26.6	31.4	30.0	26.2	26.8	27.8	30.5	35.1	35.6	38.6	41.4	39.4	37.0	38.6
Misc Capital	96.9	2.4	25.4	52.4	33.6	4.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total	2,022.7	162.6	162.3	227.5	213.8	209.6	185.3	170.0	234.5	368.0	255.2	421.4	304.4	428.7	295.9	448.2
SHOREHAM IN-SERVICE																
Shorham O&M & KAdds	1,687.9	243.3	202.6	188.9	194.5	187.3	184.8	188.3	191.8	195.2	198.8	202.2	205.8	209.3	212.8	216.3
GT - Construction	89.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	24.0	82.8	39.8	91.3	14.7	0.0
GT - O&M	6.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	(0.1)	0.0	3.4	3.4	7.4	7.6
Coal - Construction	11.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	19.2	23.0
Nuclear Fuel	177.7	0.0	0.0	5.7	25.6	36.1	18.2	18.2	43.2	24.5	24.5	51.9	27.5	27.5	58.4	31.0
Total	1,972.9	243.3	202.6	194.6	220.1	223.4	203.0	206.5	235.0	219.7	247.2	336.9	276.5	331.5	312.5	277.9
SAVINGS	49.8	(80.7)	(40.3)	32.9	(6.3)	(13.8)	(17.7)	(36.5)	(0.5)	148.3	8.0	84.5	27.9	97.2	(16.6)	170.3

REAL ECONOMIC COST - WORKPAPERS

	NPV	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
** ENERGY COMMITTEE STAFF ESTIMATES **																
SETTLEMENT																
Shoreham Decomm	381.4	149.7	54.6	37.9	71.4	75.5	46.0	30.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Fos Fuel & Purch Powe	924.3	0.0	60.1	115.2	87.6	113.2	124.6	119.9	131.0	163.3	133.7	199.7	170.4	180.3	148.3	186.1
High Prod O&M	23.7	0.0	2.1	4.5	4.7	3.9	4.1	4.3	4.5	4.7	2.0	2.1	2.2	0.0	0.0	0.0
CC - Construction	387.6	0.0	0.0	0.0	0.0	0.0	0.0	5.4	88.0	198.9	106.4	212.8	10.3	32.3	129.1	258.6
CC - O&M	48.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	11.4	11.9	24.7	25.7	40.0	41.6
GT - Construction	74.0	16.1	55.5	8.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Aggres DSM	242.4	10.5	26.6	31.4	30.0	26.2	26.8	27.8	30.5	33.1	35.6	38.6	41.4	39.4	37.0	38.6
Misc Capital	96.9	2.4	25.4	52.4	33.6	4.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total	2,179.1	178.7	224.3	250.3	227.3	223.0	201.5	187.4	254.0	400.0	289.1	465.1	249.0	277.7	354.4	524.9
SHOREHAM IN-SERVICE																
Shorham O&M & kAdds	1,158.1	0.0	67.2	139.9	145.5	151.3	157.3	163.6	170.2	177.0	184.0	191.4	199.1	207.0	215.3	223.9
GT - Construction	89.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	24.0	82.8	39.8	91.3	14.7	0.0
GT - O&M	6.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	(0.3)	0.0	3.4	3.4	7.4	7.6
Coal - Construction																
Nuclear Fuel	177.7	0.0	0.0	5.7	25.6	36.1	18.2	18.2	43.2	24.5	24.5	51.9	27.5	27.5	58.4	31.0
Total	1,431.6	0.0	67.2	145.6	171.1	187.4	175.5	181.8	213.4	201.5	232.4	326.1	269.8	329.2	295.8	262.5
SAVINGS	747.5	178.7	157.1	104.8	56.3	35.6	26.0	5.6	40.6	198.6	56.6	139.0	(20.7)	(51.5)	58.5	262.4

DEMAND SIDE MANAGEMENT - WORKPAPERS

DSM COSTS	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
Aggr. DSM ($MM)	$10.5	$26.6	$31.4	$30.0	$26.2	$26.8	$27.8	$30.5	$33.1	$35.6	$38.6	$41.4	$39.4	$37.0	$38.6
DSM Savings (MW)	0	0	120	170	190	205	220	230	240	250	260	270	280	280	280
DSM Savings (GWh)	0	50	90	150	200	230	250	285	305	340	380	390	400	400	395

	=== 1988-2002 ===		=== 1990-2002 ===	
	NPV	Lvl'd Val	NPV	Lvl'd Val
DSM Cost	242.4	29.0	251.4	30.0
MW Savings	1383.1	165.3	1673.5	214.2
GWh Savings	1716.3	205.1	2021.8	258.7
Cost per kW	175.3		140.3	
Cost per kWh	14.1		11.6	

Base DSM ($MM)	$11.0	$11.4	$11.9	$12.4	$12.9	$13.4	$13.9	$14.5	$15.1	$15.7	$16.3	$16.9	$17.6	$18.3	$19.0
DSM Savings (MW)	65	95	20	20	20	20	20	20	20	20	20	20	20	20	20

	=== 1988-2002 ===		=== 1990-2002 ===	
	NPV	Lvl'd Val	NPV	Lvl'd Val
DSM Cost	114.8	13.7	113.0	14.5
MW Savings	280.5	33.5	156.3	20.0
Cost per kW	409.1		723.1	

	88-02	90-02
Avg Agg Cost	31.6	33.6
Avg Agg MW Saved	199.7	230.4
Ave Agg $/kw	158.1	145.7
Avg Base Cost	14.7	15.2
Avg Base MW Saved	28.0	20.0
Avg Base $/kw	524.5	761.2

FUEL SAVINGS - WORKPAPERS

INTERPOLATION OF PSC FUEL EXPENSES BY CATEGORY &
ADJUSTMENT OF FOSSIL COSTS FOR DRI OIL PRICE 1

YEAR	PSC O/S POWPUR PER MAPS	PSC O/S NMP2 PER MAPS	PSC O/S FOSSIL PER MAPS	PSC I/S POWPUR PER MAPS	PSC I/S NMP2 PER MAPS	PSC I/S SHOR PER MAPS	PSC I/S FOSSIL PER MAPS	RATIO OF DRI P.: PSC P.	RATIOED DRI O/S FOSSIL	RATIOED DRI I/S FOSSIL	PSC FUEL SAVINGS	DRI FUEL SAVINGS	DELTA FUEL SAVINGS W/DRI	DELTA TOTAL FOSSIL O/S-DRI	DELTA TOTAL FOSSIL I/S-DRI
Notes:															
1987															
1988	95.1	6.7	367.8	95.1	6.7	0.0	367.8	100.00%	367.8	367.8	0.0	0.0	0.0	0.0	0.0
1989	100.6	7.1	389.0	97.2	7.6	39.0	299.3	107.20%	417.0	320.8	53.6	60.1	6.5	28.0	21.6
1990	106.0	7.5	410.0	92.6	7.3	37.2	285.1	111.11%	455.6	316.8	101.3	115.2	13.9	45.6	31.7
1991	157.5	7.6	402.2	146.6	7.3	26.4	312.7	115.12%	463.0	360.0	74.1	87.6	13.5	60.8	47.3
1992	326.6	11.6	283.4	263.8	11.2	39.6	207.0	117.56%	333.1	243.4	99.8	113.2	13.4	49.8	36.4
1993	345.6	9.1	308.8	277.0	8.8	41.2	228.2	120.11%	370.9	274.0	108.4	124.6	16.2	62.1	45.9
1994	344.2	12.3	331.0	281.9	12.1	42.7	248.3	121.08%	400.8	300.6	102.5	119.9	17.4	69.8	52.3
1995	395.1	9.6	355.5	330.6	9.4	44.2	264.4	121.39%	431.6	321.0	111.5	131.0	19.5	76.1	56.6
1996	446.4	13.5	398.3	377.2	13.1	46.6	289.9	129.53%	516.0	375.5	131.3	163.3	32.0	117.6	85.6
1997	455.8	9.9	407.4	403.3	10.1	46.9	313.0	135.93%	553.7	425.5	99.8	133.7	33.9	146.4	112.5
1998	468.0	13.8	462.5	394.9	13.3	47.2	339.5	140.81%	651.2	478.0	149.5	199.7	50.2	188.7	138.5
1999	462.2	10.4	496.4	410.5	10.5	48.7	380.4	144.33%	716.5	549.1	119.0	170.4	51.4	220.1	168.6
2000	473.8	14.4	548.0	425.4	14.6	51.5	422.9	146.68%	803.8	620.3	121.9	180.3	58.4	255.8	197.4
2001	480.0	11.0	587.8	447.6	11.5	53.7	476.1	152.33%	895.4	725.3	89.8	148.3	58.5	307.6	249.2
2002	499.6	15.1	648.9	465.2	15.8	56.1	517.1	158.21%	1026.6	818.1	109.4	186.1	76.7	377.7	301.0